Simfit

Tutorials and worked examples for simulation, curve fitting, statistical analysis, and plotting.
http://www.simfit.org.uk

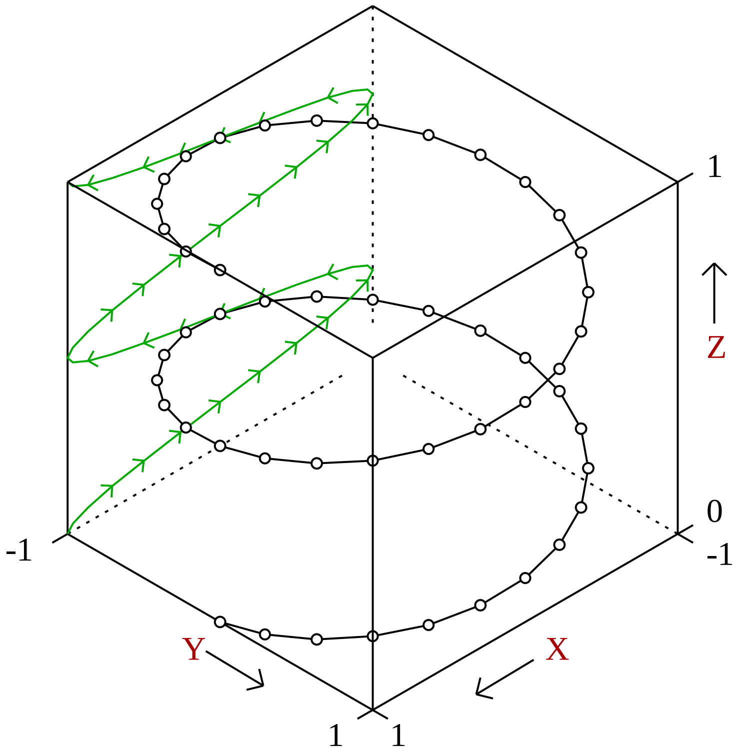
Three dimensional space curves

Sets of x, y, z coordinates can be plotted in three dimensional space to represent either an arbitrary scatter of points, a surface, or a connected space curve. Arbitrary points are best plotted as symbols such as circles or triangles, surfaces are usually represented as a mesh of orthogonal space curves, while single space curves can be displayed as symbols or may be connected by lines. For instance, space curves of the form

$$x = x(t), y = y(t), z = z(t)$$

can be plotted by generating x, y, z data for constant increments of t and joining the points together to create a smooth curve as in the next figure.

x(t), y(t), z(t) curve and projection onto y = - 1



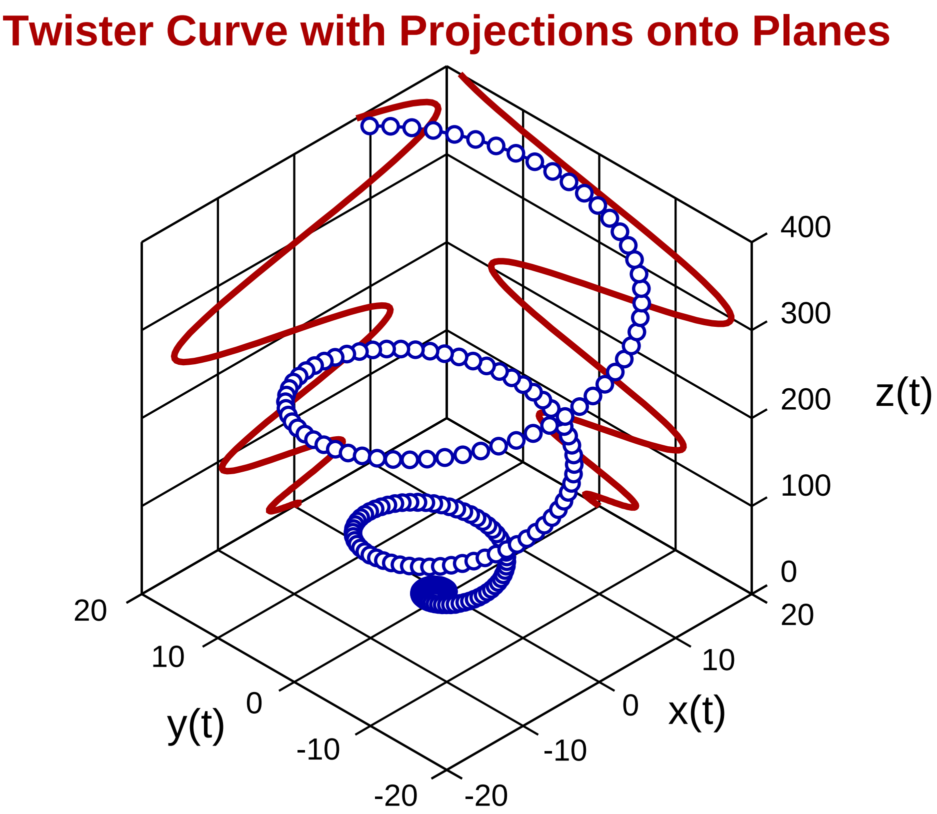
Such space curves can be generated quite easily by preparing data files with three columns of x, y, z data values, then displaying the data using the space curve option in **simplot**. However users can also generate space curves from $x(t), y(t), z(t)$ equations, using the option to plot parametric equations in **simplot** or **usermod**. The test file `helix.mod` shows you how to do this for a three dimensional helix. Note how the rear (x, y) axes have been subdued and truncated just short of the origin, to improve the three dimensional effect. Also, projections onto planes are generated by setting the chosen variable to a constant, or by writing model files to generate x, y, z data with chosen coordinates equal to the value for the plane.

Projecting space curves onto planes

Sometimes it is useful to project space curves onto planes for purposes of illustration. The next figure shows a simulation using **usermod** with the model file `twister.mod`. The parametric equations are

$$x = t\cos t, y = t\sin t, z = t^2$$

and projections are created by fixing one the variables to a constant value.



Note the following about the model file `twister.mod`.

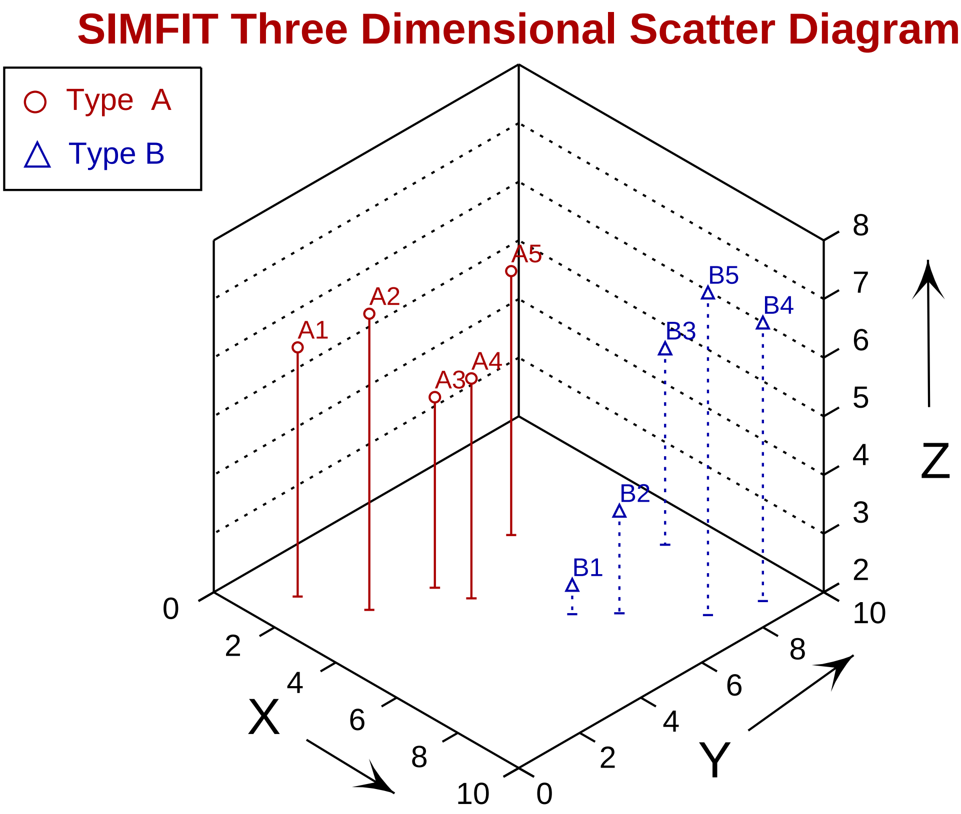
- There are 3 curves so there are 9 functions of 1 variable
- The value of x supplied is used as the parameter t
- Functions $f(1)$, $f(4)$, $f(7)$ are the $x(t)$ profiles
- Functions $f(2)$, $f(5)$, $f(8)$ are the $y(t)$ profiles
- Functions $f(3)$, $f(6)$, $f(9)$ are the $z(t)$ profiles

Also observe that the model parameters fix the values of the projection planes just outside the data range, at

$$p(1) = 20, p(2) = 20.$$

Three dimensional scatter diagrams

Often it is necessary to plot sets of x, y, z coordinates in three dimensional space where the coordinates are arbitrary and are not functions of a parameter t. This is the case when it is wished to illustrate scattering by using different symbols for subsets of data that form clusters according to some distance criteria. For this type of plotting, the sets of x, y, z triples, say principal components, are collected together as sets of three column matrices, preferably referenced by a library file, and a default graph is first created. The usual aim would be to create a graph looking something like this.



In this graph, the front axes have been removed for clarity, a subdued grid has been displayed on the vertical axes, but not on the base and perpendiculars have been dropped from the plotting symbols to the base of the plot, in order to assist in the identification of clusters.

Note that plotting symbols, minus signs in this case, have been added to the foot of the perpendiculars to assist in visualizing the clustering. Also, note that distinct data sets, requiring individual plotting symbols, are identified by a simple rule; data values in each data file are regarded as representing the same cluster, i.e. each cluster must be in a separate file.